The effect of menus and signposting on the speed and accuracy of sense selection

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Abstract

A number of dictionaries include numbered 'signposts' in polysemous dictionary entries. These may be placed in a ‘menu’ at the top of the entry, or distributed as 'shortcuts' before each meaning. This study compares the effect of three versions of entries for MED2 'red' words (i.e. those of particular usefulness to learners): with their original menus, without menus, and with the menu information dispersed within the entry. Participants selected appropriate meanings from a paper-based mini-dictionary, and a purpose-built quiz type program recorded their answers and the time taken to select each meaning. A total of 2109 consultations were recorded. Selection time with and without signposting did not differ significantly, but responses to entries containing shortcuts were significantly more accurate than responses to entries with no signposting. Surprisingly, the last sense in the entry proved easiest to identify. A positive correlation between proficiency score and test score was noted.

1. Introduction

Many common word forms in English have several different meanings, but there is a well-documented tendency for dictionary users to select the first definition they encounter in polysemous entries, regardless of appropriacy in context (Tono 1984; Nesi 1987, Nesi and Haill 2002; Bogaards 1998). This is because the first definition is the first that users read, so choosing it shortens their dictionary consultation time, and it is also because the first definition usually represents the most familiar meaning, and is thus most likely to confirm any knowledge they already have about the meaning of the word. Of course, users are only likely to look up a relatively common polysemous word when its most frequent meanings do not seem to make sense in the context of the text they are reading. It is therefore important that they should look beyond the first sense listed in the entry, to see if another less frequent sense is the one intended. One way of trying to help users to do this is to include devices to guide them towards the most appropriate meaning: these may occur at the beginning of entries, as ‘menus’ (MED), or within entries, as ‘signposts’ (LDOCE), ‘guidewords’ (CIDE) or 'shortcuts' (OALD). However, although many learners’ dictionaries now use one or other of these methods, and a number of studies have examined their effects (Tono 1992, 2001; Bogaards 1998; Lew and Pajkowska 2007, Lew 2010), there are still doubts about the efficacy of the approach in terms of its ability to reduce the time taken to select a definition, and to increase the accuracy of selection choice.

Tono studied the effect of entry-initial menus (1992) and entry-internal signposting (2001), with somewhat inconclusive results. The effectiveness of entry-internal signposting in LDOCE and CIDE seemed to be affected by entry length and the way the meanings were clumped or separated in the entry. High school subjects seemed to benefit from entry-initial menus, but there was no significant difference between the performance of university level subjects with and without menu access. In this volume, Tono reports similar findings from a small group of university students. Entry-initial menus were used effectively by lower proficiency subjects but tended to be ignored by the more advanced subjects. Both groups, on

the other hand, performed worse with entry-internal signposts than without them, and although eye-tracking showed that subjects who were conversant with this kind of signposting were able to scan the entry structure and speed up the consultation process, most of the lower proficiency subjects ignored the signposting, and subjects in both groups were misled by signposts which over-simplified word meanings.

Bogaards (1998) compared the speed and accuracy with which secondary school students selected and translated word meanings in the 1995 editions of LDOCE, CIDE, OALD and COBUILD. In this study the entries with signposts (LDOCE3) and guidewords (CIDE) proved more efficient and popular than COBUILD2, which had a grammar-based access structure, and OALD5, which did not provide any access guidance at all. Lew and Pajkowska (2007) adapted the guided sentence translation task Bogaards used to test accuracy in order to gauge the effect of entry length on the use of signposts in LDOCE4 entries. Speed of selection and translation accuracy were found to be significantly better for short entries than for long entries, but despite a neat design and careful control of variables Lew and Pajkowska's experiment revealed no significant differences in terms of access time, sense selection or translation accuracy for short or long LDOCE entries, whether they contained their original signposts or not. Lew and Pajkowska also tested the effect of proficiency by comparing the results of their secondary school student participants at pre-intermediate and at intermediate level. Signposting was not found to be more helpful to the less proficient users, however.

Lew (2010) returned to the vexed question of signposting using a similar translation task to compare high and low proficiency secondary school students' speed and accuracy when working with entries from OALD7. Half the participants had access to unmodified entries, where signposts or 'shortcuts' were positioned before each sense, and half had access to modified entries where the shortcuts had been repositioned at the beginning of each entry, in the manner of Macmillan menus. Sense access time proved to be unaffected by the two conditions but accuracy was greater for shortcut users, significantly so in the translation task. Lew speculates that this may be because the proximity of the shortcut item to the sense makes it easier for users to relate the one to the other, and thus flesh out the shortcut information with details provided in the relevant part of the entry. Menu items are located at a distance from the sense and perhaps this makes it more difficult for users to navigate from the menu to the relevant section of the entry. In Lew's study the high proficiency learners were more accurate than the low proficiency learners, but surprisingly they took slightly longer to locate senses.

Several of the findings from these studies suggest tendencies that might have reached significance level if the quantity of data had been greater. The current study aims to examine the effects of signpost inclusion and positioning in a different educational context, using a somewhat larger dataset and more precise timing methods than the manual methods used in previous studies, for example entailing a show of hands. The study tests the following hypotheses, developed in the light of previous findings:

1. Signposting of any kind will increase the speed of polysemous dictionary entry consultation.
2. The positioning of signposts will affect consultation speed.
3. Signposting of any kind will increase the accuracy of polysemous dictionary entry consultation.
4. The use of shortcuts positioned just before the relevant sense will result in greater sense selection accuracy than the use of menus at the top of the entry.
5. Proficiency will increase accuracy, but not speed of access.

6. Scores and speed of access will be higher for senses occurring early in the entry.
7. Scores will be higher for shorter entries.
8. Speed of access will be higher for shorter entries.

2. The study

In the Macmillan English Dictionary (MED) 7,500 words are printed in red to indicate that they are high-frequency core vocabulary which the dictionary considers essential for fluent interaction with native speakers. Many of these words are polysemous, but they are of course more often used in some senses than in others. Senses are listed in the entry in order of frequency, and entries with five or more senses have a menu at the top 'to make it easier to find the specific meaning you are looking for' (MED2: ix).

Eighteen entries for MED2 red words were selected for the study. The target headwords were:

- 9 nouns: *column, estate, machine, magazine, mole, package, plant, pool, resistance*
- 5 adjectives: *mean, personal, poor, pure, regular*
- 4 verbs: *occupy, produce, qualify, receive*

Five distinct meanings, numbered from one to five, are listed in the MED2 entries for each of these words. Entries range in length from 88 words (*magazine*) to 395 words (*qualify*).

Most dictionaries that use signposting deploy three distinct types, which summarise the meaning, relate to the context in which the meaning is used, or relate to the pragmatic use of the word. In the MED2 menus, for example, the first three meanings of *column* are signposted by short definitions:

1. tall thick post
2. sth rising into the air
3. line of people/vehicles.

This kind of signpost is by far the most common. The last two meanings of *column*, however, are signalled by information about the things that are described as 'columns', and where columns occur:

4. of writing/numbers
5. in newspaper/magazine.

Occasionally the signpost indicates the reason for using the meaning, as in Sense 2 in the MED2 menu for *pure*:

2. for emphasis.

and Sense 5 in the MED2 menu for *poor*:

5. feeling sorry for sb.

The types of signposting and the extent to which they are used vary from dictionary to dictionary. LDOCE5, for example, does not provide shortcuts for many of the words chosen for this study: the nouns *column, estate, machine, magazine, mole* and *package*, and the adjective *personal*. It also only provides shortcuts for some of the meanings of the adjectives *mean* and *pure* and the verbs *occupy* and *receive*. MED2, on the other hand, lists in its menus every sense provided in the subsequent entries.

For this study all the MED2 entries for the target words were reproduced in three formats: the original MED2 format using a menu bar with black print on a red background, a new format without any signposting, and a new format where menu information was dispersed as red, upper-case signposts within the entry. This system differs from, and complements, the

work of Lew (2010), who compared the effect of an original shortcut format (from OALD7) and a new format where shortcut information was gathered into menus.

Three versions of a hard-copy mini-dictionary were prepared, listing all the words in alphabetical order and rotating the three formats. Thus Version One of the mini-dictionary began with a menu entry for *column*, an entry without any signposting for *estate*, and a signpost entry for *machine*, whereas Version Two began with a signpost entry for *column*, a menu entry for *estate*, and an entry with no signposting for *machine*, and Version Three began with an entry with no signposting for *column*, a signpost entry for *estate* and a menu entry for *machine*, and so on. Thus each mini-dictionary contained entries in each format, and each subject was exposed to entries in each condition.

The participants in the study were 124 second and third year undergraduate students studying at a university in Malaysia. Roughly equal numbers came from a Faculty of Business and Economics and a Faculty of Education. Rather than dividing the participants into intermediate and advanced level groups, each participant's English language proficiency level was calculated in terms of their MUET (Malaysian University Entrance Test) results. MUET scores are expressed in Bands, from Band Six, the highest proficiency level, to Band One, the lowest. The mean score for the participants in the study was 3.62 (s.d. 0.87); most of the participants were in Bands Three, Four and Five, but three were in Band Two, and one was in Band Six.

For the experiment, each participant was given a version of the print mini-dictionary and was required to identify the correct word senses used in a series of phrases and sentences taken from the BAWE corpus of proficient university student writing.[1] The sentences were extracted from assignments written for degree coursework in various disciplines, and were considered to represent the kind of writing that the participants might encounter in their own studies, and might aim to produce themselves. A translation component was not included in the test as the participants study in the medium of English. The target words were underlined in the sentences and presented in the same (alphabetical) order as in the mini-dictionaries. Senses were distributed fairly evenly across all five subentries; in four of the entries the correct sense was Sense 1, in four Sense 2, in three Sense 3, in three Sense 4 and in four Sense 5. The eighteen sentences used in the experiment are reproduced in Appendix 1.

The sense identification task was presented on-screen, using a purpose-built Moodle-based test. One sentence was displayed at a time, and the five sense numbers were presented in a multiple choice question format. Participants could not return to previous sentences, or revise their answers. The test was initially trialled with two students for usability, and the instructions and the location of the answer buttons were subsequently improved in response to their feedback. A clock embedded in the test automatically calculated the amount of time each participant took to select the correct word sense after having obtained access to each sentence.

Initially 150 participants took part, and were permitted to take the test at a time and place of their own choosing, taking breaks and returning to the test whenever they wished. They were told that although their dictionary consultations would be timed from the moment they accessed each new sentence until the moment they selected the word sense number, the amount of time they spent between questions would not be recorded. Data was analysed for only 124 participants, however, because seven failed to complete the test, and 19 took five minutes or more to identify senses for the majority of the target words. In this case we suspected that they had been distracted from the task, and thus the time recorded was not a true indication of the time they needed to identify the senses. We therefore deemed it safer to discount all the data recorded for these participants. In the data we analysed, consultation

times ranged from 316 to 2 seconds, except in one case where a participant took 414 seconds to decide on an answer to one question (question 7: *occupy*, Sense 2). A total of 2109 consultations were recorded, with a mean consultation time of 22.96 seconds, s.d. 27.03.

Of the 124 participants, 43 used Version One of the mini-dictionary, 40 used Version Two and 41 used Version Three. All the participants were familiar with Moodle and similar IT applications. They were briefed in class prior to the test, and were told that they were taking part in an experiment to investigate the way that dictionaries could help students find word meanings. The briefing did not, however, draw attention to the three entry formats in the mini-dictionaries. As the entry for one of the 18 target words, *resistance*, was used during the briefing as a trial question so that participants could acquaint themselves with the functioning of the online test, consultation times and selection choices were only recorded for 17 target words.

In the online test participants were asked to locate and tick the most relevant sense of the five given in the dictionary entry. In this respect the task was unlike a real-life dictionary consultation, because it required participants to find the meaning number regardless of whether they recognised the sense in context or not. All the words are regarded by the MED as core vocabulary, and we assumed some of these senses would already be familiar to some participants. Appendix 2 shows the format of the trial question.

3. Results

Hypothesis 1 predicted that signposting of any kind would increase the speed of entry consultation, and Hypothesis 2 predicted that the positioning of the signposts would also have an effect in this regard.

The mean time taken in each of the three conditions is shown in Table 1.

Table 1. Mean consultation time (in seconds)

Condition	Time	Std. Deviation.
Menus	22.54	17.06
Shortcuts	19.82	12.65
No Signposts	23.22	18.86

T test comparisons of time taken in the three conditions are shown in Table 2. Both hypotheses were rejected, as there was no significant difference in the time participants took to select word senses in entries with or without signposting, and the positioning of signposts did not significantly affect consultation speed.

Table 2. T test results for speed of consultation

Time	*t*	df	Probability
Menus v. No Signposts	-0.28	123	0.78
Menus v. Shortcuts	1.38	123	0.17
Shortcuts v. No Signposts	-1.61	123	0.11

Hypotheses 3 and 4 predicted that signposting would increase selection accuracy, and that shortcuts would be more efficient than menus in this respect. Mean test scores in the three conditions, maximum 1 and minimum 0, are shown in Table 3.

Table 3. Mean test scores

Condition	Score	Std. Deviation
Menus	0.79	0.19
Shortcuts	0.82	0.18
No Signposts	0.79	0.19

Comparisons of scores in the three conditions are shown in Table 4.

Table 4. T test results for accuracy

Score	*t*	df	Probability
Menu v. No Signposts	0.58	123	0.56
Menus v. Shortcuts	-0.89	123	0.38
No Signposts v. Shortcuts	-6.96	123	<0.01

Although menu use did not result in significantly more accurate selections, and there was no significant difference between the scores for menus and the scores for shortcuts, there was a significant difference between the scores for shortcuts and the scores for entries without any signposting. Thus although selection accuracy was not significantly increased with all types of signposting (Hypothesis 3), shortcuts did seem to be more efficient than menus (Hypothesis 4).

Hypothesis 5 predicted that proficiency would have a positive impact on accuracy, but not on speed of access. To test this hypothesis we correlated test scores, time taken to select meaning, and the participants' proficiency as measured by their band scores on the Malaysian University Entrance Test (MUET). The hypothesis was accepted because there was a significant positive correlation between MUET band and scores for all entries in the three different conditions. For entries with menus, r (122) = 0.228, p = 0.011, for entries without any signposting at all, r (122) = 0.223, p = 0.013, and for entries with shortcuts, r (122) = 0.274 , p = 0.002. However, the strength of the relationship in all conditions, though positive, was not strong. There was no discernible correlation between band score and the time taken to select senses in any of the conditions.

Hypothesis 6 predicted that scores and speed of access would be higher for senses occurring early in the dictionary entry, on the grounds that early senses were the first listed in the menus, and were probably the first that users would read in shortcuts and in unsignposted entries. Earlier senses are also the most common ones, and were therefore the senses that participants would be most familiar with.

As anticipated, a high percentage of participants correctly selected the first sense in the entry. Unexpectedly, however, participants found the last of the five senses most quickly and most successfully, and seemed to have greatest problems identifying senses in the middle, particularly Sense 3. This variation is shown in Table 5.

Table 5. Mean times, scores and standard deviations for each sense

Sense Number	Mean Time	Std. Deviation	Mean Score	Std Deviation
Sense 1	23.01	26.83	0.94	0.24
Sense 2	23.14	30.15	0.67	0.47
Sense 3	24.89	24.17	0.64	0.48
Sense 4	27.37	35.67	0.79	0.41
Sense 5	17.04	19.08	0.97	0.17

T tests revealed significant score differences between all pairs except for S2 and S4. They also revealed differences between the time taken to select senses in different positions in the entry. These were highly significant for Sense 5 compared to all the other senses ($p \leq 0.001$), and significant for Sense 4 compared to Senses 1 and 2 ($p \leq 0.05$).

Table 6 summarises the effects of positioning and signposting on participants' scores. The results accord with those presented in Table 3: the correct selections for entries with shortcuts was greater than in the other two conditions, regardless of sense number. Across all three conditions participants were most successful in identifying Senses 1 and 5.

Table 6. Scores in each position and condition

Sense Number	Menus		Shortcuts		No Signposts	
	Mean Score	Std Deviation	Mean Score	Std Deviation	Mean Score	Std Deviation
Sense 1	0.95	0.22	0.95	0.22	0.93	0.26
Sense 2	0.62	0.49	0.70	0.46	0.68	0.47
Sense 3	0.65	0.48	0.67	0.47	0.60	0.49
Sense 4	0.78	0.42	0.80	0.40	0.78	0.41
Sense 5	0.96	0.20	0.99	0.11	0.96	0.17

Hypotheses 7 and 8 predicted that entry length would affect efficiency, and that scores and speed of access would be higher for shorter entries. In Table 7, questions have been rearranged in order of entry length so that any relationship between length, time and score can be more apparent. The average entry length was 193 words.

Table 7. Entry length, definition length, times and scores for each question

Question	Sense number	Word length of entire entry	Word length of definition	Mean time	Number correct / 124
Q4, magazine	1	88	22	19.47	122
Q6, mole	5	95	14	16.23	121
Q8, package	2	118	26	22.87	88
Q1, column	4	122	31	42.32	98
Q5, mean	4	122	20	15.41	118
Q10, plant	2	134	21	18.90	115
Q11, pool	5	153	18	21.70	120
Q12, poor	5	162	7	13.18	121
Q2, estate	1	182	23	29.98	110
Q3, machine	3	290	22	26.20	92
Q14, pure	2	185	12	26.23	57
Q17, regular	3	219	19	29.43	56
Q16, receive	5	221	18	17.78	116
Q13, produce	1	252	17	19.60	119
Q7, occupy	2	256	30	27.66	72
Q9, personal	4	292	14	24.39	70
Q15, qualify	3	395	22	19.05	91

Hypothesis 7 was rejected, as there was no discernible correlation between selection success and the length of the entry or definition. Hypothesis 8, however, was accepted, because although entry length did not correlate with the amount of time taken to select word senses, there was a significant positive correlation between the two variables of definition length and time, where $r = 0.605$, indicating a moderate relationship. Correlation results are shown in Table 8.

Table 8. Correlations between length, speed and score

Pair	Correlation Coefficient (*r*)	*p*
Definition length and selection time	0.605	0.010
Definition length and score	-0.435	0.081
Entry length and selection time	0.050	0.849
Entry length and score	-0.438	0.079

The three words which attracted the lowest scores were adjectives: *regular*, *pure* and *personal*, and it was found that in general participants made most mistakes when selecting senses for adjectives, and fewest mistakes when selecting senses for nouns, as shown in Table 9.

Table 9. The percentage of correct scores according to word class

Word Class	Menus	Shortcuts	No Signposts	All conditions
Nouns	86%	90%	74%	87%
Adjectives	69%	73%	62%	68%
Verbs	76%	82%	83%	80%

4. Discussion

In prior studies users were found to benefit from signposting (Bogaards 1998), although there has been disagreement over whether signposting is more beneficial to lower proficiency users (Tono 1992) or is equally beneficial at both lower and higher levels (Lew and Pajkowska 2007). Shortcuts have been found more helpful to users than menus (Lew 2010), and the positioning of signposts and the length of entries has not appeared to affect consultation time (Lew and Pajkowska 2007).

The findings of this study broadly confirm this prior research, although our participants' scores for similar tasks are somewhat higher. They chose senses correctly in 82% of cases when using shortcuts, and 79% of cases when using menus, while in Bogaards' study (1998) the translations by LDOCE and CIDE signpost users were 70% and 71% accurate, and in Lew and Pajkowska's study (2007) signpost users achieved 71% translation accuracy, and 79.9% sense selection accuracy. In Lew (2010) rates were considerably lower: shortcut users only attained 50% translation accuracy and 29% sense selection accuracy, and menu users only attained 45% translation accuracy and 25% sense selection accuracy. The superior scores of our participants may be due to proficiency level and study skills experience, as they were university students studying in an ESL context, whereas Bogaards (1998), Lew and Pajkowska (2007) and Lew (2010) all worked with high school students who were learning English as a foreign language. It is also possible that the MED signposts were more helpful than the signposts in LDOCE4 (Lew and Pajkowska 2007) and in OALD7 (Lew 2010).

As in prior studies scores were highest for the entries with shortcuts, although neither form of signposting made consultation significantly faster. Participants with lower band scores had

significantly less chance of making correct sense choices, particularly when the entry did not include any signposting to aid selection. The correlation between the experiment scores and English language proficiency scores was significant and positive ($r = 0.274$, $p = 0.002$ for entries with shortcuts, $r = 0.228$, $p = 0.011$ for entries with menus, and $r = 0.223$, $p = 0.013$ for entries without any signposting at all).

New findings to emerge from our study concern the role of definition location and length. Participants had least difficulty when a test question required them to identify the first or last sense in an entry, and the senses identified with the greatest speed and accuracy were those at the end. This raises the possibility that the middle part of a dictionary entry is less salient than its beginning or ending, just as the middle part of a word is less memorable than its extremities, a widely acknowledged phenomenon known as the 'bathtub effect' (Aitchison 1987: 119). It is possible that, as experienced dictionary users, the participants may have developed a strategy to examine entries of common words working their way from the bottom up, having discovered that the early senses are always familiar and therefore not the most useful when consulting the dictionary for decoding purposes. This does not explain, however, why they took longest to consult Sense 4, and were so much less successful in identifying Sense 4 than Sense 5. More research is needed to establish whether the bathtub effect persists regardless of entry length, and whether Sense 3, for example, becomes salient in a three-sense entry, while Sense 5 loses salience in an entry with more than five senses.

The experiment was not designed to test the effect of word class, and because of the uneven distribution of senses across entries for different word classes it is impossible to say with certainty whether word class was a factor influencing selection success. However, although adjectives and verbs generally proved more problematic in this study, a very high number of participants correctly identified Sense 5 for the adjective *poor*, and most participants correctly identified the meaning of the verbs *produce* (Sense 1) and *receive* (Sense 5). This suggests that sense location or possibly the nature of the menu information were stronger predictors of look-up success or failure than word class.

Participants had most difficulty with the adjective *regular* in Sense 2, which is signposted by the synonym 'ordinary'. ‘Ordinary’ can be substituted for *regular* in the quiz sentence without any further adjustment, and therefore the signpost wording does not appear to pose particular problems. Some other factor must account for the difficulty participants experienced. They were probably familiar with *regular* in other senses, so it is possible, for example, that they found it difficult to accept that *regular* and *ordinary* were synonyms in the given context. On the other hand the signposts for Sense 2 of the adjective *pure*, Sense 4 of the adjective *personal* and Sense 2 of the verb *occupy*, the three other senses which proved most difficult to identify, cannot act as substitutes for the target words in the quiz sentences. The signpost for Sense 2 of *pure* provides pragmatic information ('for emphasis'), while the relevant signposts for *personal* and *occupy* are highly truncated definitions ('with direct relationship' and ' be in control of place'). These would need extensive adjustment in order to fit into the sentence contexts. Of the four words that participants found easiest (*magazine, mole, pool* and *poor*), two of the correct senses are signposted with substitutable expressions ('regularly published book', 'unit of molecules' and one with a short definition which cannot easily replace the target word in context ('group sb/sth chosen from'). One refers to the circumstances in which the sense would be used ('feeling sorry for sb').

The wording of the signposts doubtless affects speed and accuracy of consultation, but some meanings are clearly far easier than others for lexicographers to signpost and define, and for dictionary users to understand. More research is needed to discover the best ways to

signpost meanings, especially those which are more abstract, and are not associated with specific contexts or collocation sets.

The findings displayed in Table 6 suggest that entry-initial menus and entry-internal shortcuts aided users to identify the first four senses, but did not play a role in the successful identification of Sense 5. This seems rather counter-intuitive, as signposts are intended to help users navigate long entries. The Macmillan English Dictionary, for example, only provides menus for entries with five or more senses, and we would not expect signposting to improve access to Sense 1, usually regarded as the default definition which users fail to go beyond. It should be noted, however, that in Tono's eyetracking study (this volume) lower proficiency users had difficulties retrieving meaning even when the relevant definition was placed early in the entry. Overall entry length did not seem to affect outcomes in any way, but participants found meanings significantly more quickly when the definitions were shorter. Again, more research is needed to investigate whether consultation speed increases because a definition is shorter, or whether shorter definitions are easier to process because they are used for meanings that are easier to define.

Many factors must be acknowledged when examining the interrelated effects on look-up success of signpost provision, sense position, word meaning and definition length. User behaviour may be influenced by such things as the clarity of the definitions, the inherent appeal of a particular meaning or the contexts in which it is used, or the fact that a translation equivalent covers a similar or different range of meanings in the user's first language. It is impossible to control for the possible interplay of all these factors, and experimental findings must therefore always be treated with caution. Nevertheless this study does seem to have some implications for dictionary makers and dictionary users. It supports prior indications that shortcuts are more helpful to users than menus, and it also raises the possibility that signposts are useful in shorter entries, not only in those containing five definitions or more. In MED2 each sense begins on a new, numbered line, and it is hard to see how this layout might be improved to raise the salience of meanings in the middle of the entry. This central trouble spot may be a problem that dictionary skills training can address, by drawing users' attention to the possible dangers of a 'bathtub effect'.

Notes

1. See www.coventry.ac.uk/bawe and Alsop and Nesi (2009) for a more detailed description of the design and contents of the BAWE corpus.

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Appendix 1: The sentences used in the experiment

1. It has been found that Total Factor productivity accounts for over 50% of GDP growth in all major economies, as can be seen in the last column of Table 1. (*column* - MED2 sense number 4)
2. The Byker estate in Newcastle is a planned social housing development built in the 70s as part of a slum clearance project. (*estate* - MED2 sense number 1)
3. Hitler realised that to build the war machine capable of carrying out his global ambitions, Germany needed a completely new infrastructure. (*machine* - MED2 sense number 3)
4. The teenage magazine market is dominated by girls' titles, as teenage boys tend to read magazines on their hobbies and interests. (*magazine* - MED2 sense number 1)
5. The mean real GDP per capita growth rate is 2.22 %, although the maximum growth rate is an extreme 8.48 %. (*mean* - MED2 sense number 4)
6. In this experiment, 1 mole of acid reacts with 1 mole of base. (*mole* - MED2 sense number 5)
7. The main strategy was the occupation - or invasion as the government and the media call it - of private properties. The group occupied areas they considered fallow land. (*occupy* - MED2 sense number 2)
8. It would be important to ensure that a suitable home care package was arranged prior to his discharge which included daily follow-up with a physiotherapist. (*package* - MED2 sense number 2)
9. This applies where there is no financial or personal connection to either party. (*personal* - MED2 sense number 4)
10. It was arranged for students to visit at least one manufacturing plant or giant enterprise every day during the visit. (*plant* - MED2 sense number 2)
11. A limited pool of students whose medical education had been interrupted or postponed by World War II. (*pool* - MED2 sense number 5)
12. Poor Christine, you are a widow (*poor* - MED2 sense number 5)
13. Industries always look out for better techniques that optimise cost and time and produce better products. (*produce* - MED2 sense number 1)
14. It is very hard to think this passage is pure invention. (*pure* - MED2 sense number 2)
15. 16 candidates qualified for the first round, three of which were from the hard left and two from the far right. (*qualify* - MED2 sense number 3)
16. Special antennas in the wheel arches receive these radio messages and pass them on to a microcomputer. (*receive* - MED2 sense number 5)
17. 58 million Chinese teens study the Japanese occupation of China as part of their regular Chinese history courses. (*regular* - MED2 sense number 3)
18. This would be extremely difficult in practice due to the resistance of the bacteria to biocides. (*resistance* - MED2 sense number 1)

Appendix 2: The three experimental conditions

Condition 1
column

1. tall thick post	4. of writing/numbers
2. sth rising into the air	5. in newspaper/magazine
3. line of people/vehicles	

1 a tall thick post used for supporting a roof or decorating a building: *Marble columns* **1a.** a tall thick post built in a public place to honour an important event or famous person.
2 something that rises up into the air in a straight line: a column of steam and ash
3 a long line of people or vehicles moving together: *a column of soldiers*
4 a series of short lines of writing or numbers arranged one below the other on a page: *the left-hand column* ◆ *a column of text*
5 a regular newspaper o magazine article on a particular subject or by a particular journalist: *He writes a weekly column for the Daily News* ◆ *an obituary/ correspondence/political column*

Condition 2
column
1 ▸ **TALL THICK POST** ◂ a tall thick post used for supporting a roof or decorating a building: *Marble columns* **1a.** a tall thick post built in a public place to honour an important event or famous person.
2 ▸ **STH RISING INTO THE AIR** ◂ something that rises up into the air in a straight line: a column of steam and ash
3 ▸ **LINE OF PEOPLE/VEHICLES** ◂ a long line of people or vehicles moving together: *a column of soldiers*
4 ▸ **OF WRITING/NUMBERS** ◂ a series of short lines of writing or numbers arranged one below the other on a page: *the left-hand column* ◆ *a column of text*
5 ▸ **IN NEWSPAPER/MAGAZINE** ◂ a regular newspaper o magazine article on a particular subject or by a particular journalist: *He writes a weekly column for the Daily News* ◆ *an obituary/ correspondence/political column*

Condition 3
column
1 a tall thick post used for supporting a roof or decorating a building: *Marble columns* **1a.** a tall thick post built in a public place to honour an important event or famous person.
2 something that rises up into the air in a straight line: a column of steam and ash
3 a long line of people or vehicles moving together: *a column of soldiers*
4 a series of short lines of writing or numbers arranged one below the other on a page: *the left-hand column* ◆ *a column of text*
5 a regular newspaper o magazine article on a particular subject or by a particular journalist: *He writes a weekly column for the Daily News* ◆ *an obituary/ correspondence/political column*

Appendix 3: Example used in the briefing session

INSTRUCTIONS: Look at the dictionary entry below. The word *resistance* has five different meanings.

resistance

1. not being affected	4. force slowing sth moving
2. refusal of sth new	5. stopping electric flow
3. opposition to sb/sth	

1 [singular/U] the ability not to be affected or harmed by something, especially a disease or drug: **+ to** *Vitamin C helps build resistance to infection.* ◆ *Tumour cells can develop a resistance to certain drugs.*. **1a** [U] the ability of an object not to be affected or harmed by wind, water, heat etc: *The boots showed high water resistance when tested.*
2 [singular/U] refusal to accept something new such as a plan, idea, or change: **meet (with)/face/encounter resistance** *This proposal is meeting some resistance at the UN's headquarters.*
3 [singular/U] opposition to someone or something, especially a political or military opponent: *The government had taken elaborate precautions to crush any resistance.* **3a** [singular] a secret organization that fights against the group that controls their country
4 [U] PHYSICS a force that makes a moving object move more slowly: *air/wind resistance*
5 [U] PHYSICS the ability of something to stop the flow of electricity

In the following sentence one word is underlined. Match the meaning of the underlined word to the appropriate number in the dictionary entry.

Sentence:
This would be extremely difficult in practice due to the resistance of the bacteria to biocides.

sense number 1 ☐

sense number 2 ☐

sense number 3 ☐

sense number 4 ☐

sense number 5 ☐